Introduction to Virtualization

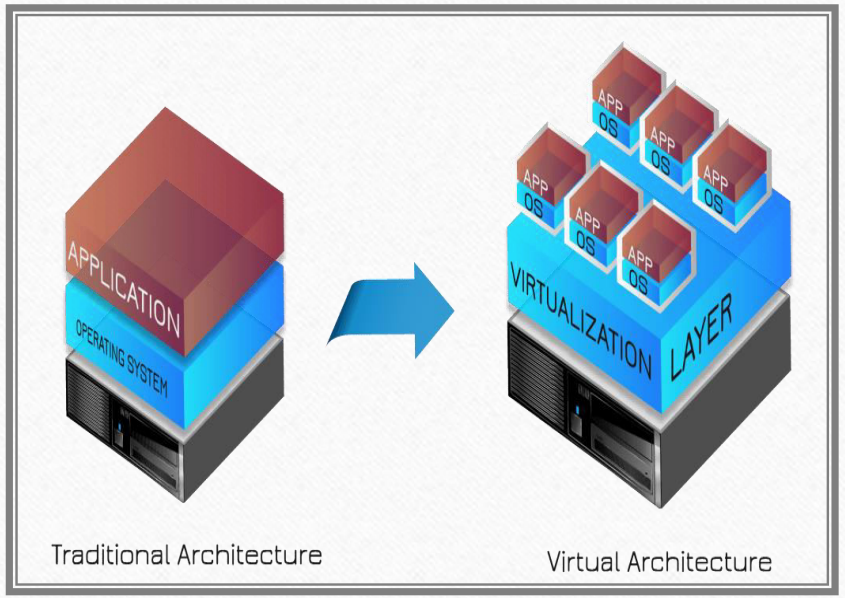
Week 1 (part 1)

In this lecture

- **Topics to be Covered**:
  - What is Virtualization?
  - Why Virtualization?
  - How Virtualization is done?

What is Virtualization?

- Pretty old but to critical to understand
- A system pretends to be two or more
- Simulation of hardware devices or features using software
- Used to create virtual version of something (like network)



Why Virtualization?

Virtual University

- Best use of resources
- Flexibility and scalability
- Increased agility
- Disaster Recovery
- Increased Security
- Cost saving

How Virtualization

- Achieved through the use of virtualization software called Hypervisor
- Hypervisor creates virtualized versions of physical resources
- Hypervisor allocates these resources to virtual machines (VMs)
- VM operates as if it were a physical machine
- Run different applications, operating systems, and services using VMs

Benefits of Virtualization

Week 1 (part 2)

Benefits of Virtualization

- **Topics to be Covered**:
  - Resource utilization
  - Scalability and flexibility
  - Improved disaster recovery and business continuity
  - Increased security

Resource Utilization

- Create virtualized versions of physical resources
- Use the same hardware more effectively
- Leading to better utilization of resources

Scalability and flexibility

- Easier to scale resources up or down as needed
- No need to make physical changes to the underlying infrastructure

Improved Disaster Recovery and Business Continuity

- Create replicas of their production environment
- Quickly activated in the event of a disaster
- Does not affects the end user

Increased Security

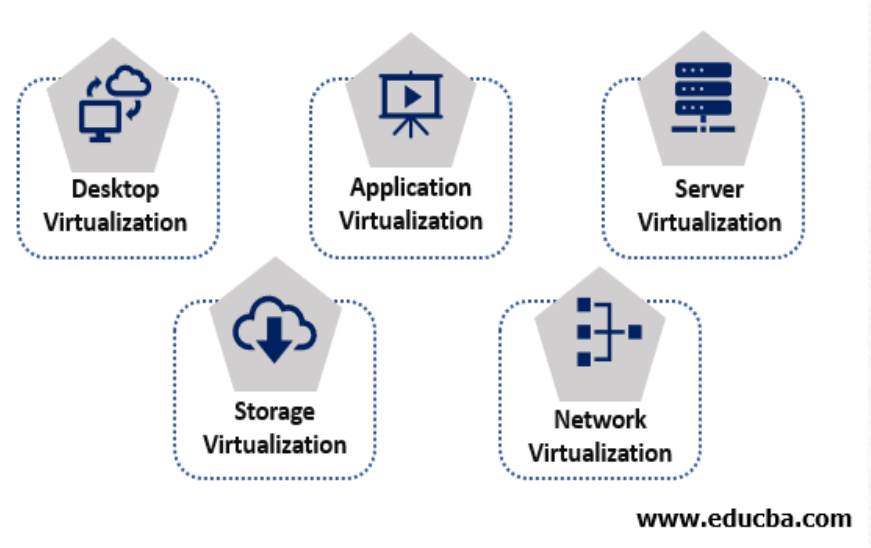
- Isolate and secure sensitive applications and data
- It becomes harder for malicious actors to access them
- Minimal to no chances of virus attack or security breach

Types of Virtualization

Week 1 (part 3)

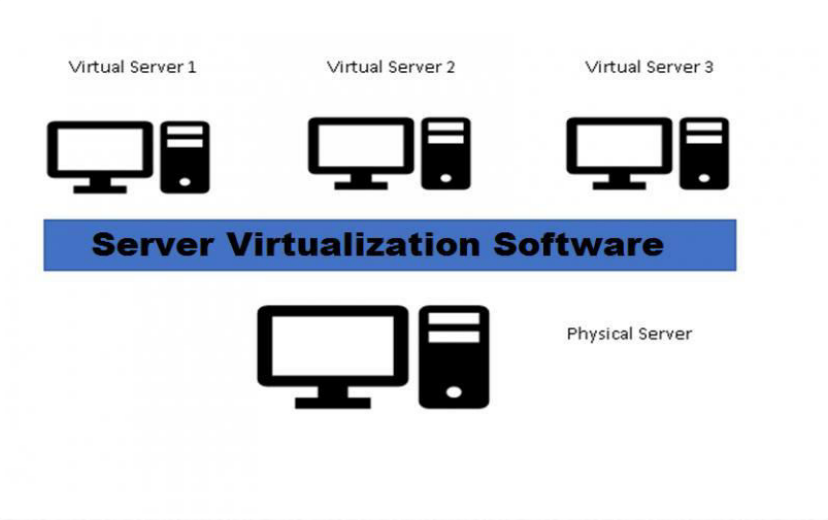
Types of Virtualization

- **Topics to be Covered:**
  - Server Virtualization
  - Desktop Virtualization
  - Application Virtualization
  - Storage Virtualization
  - Network Virtualization
  - Hardware Virtualization



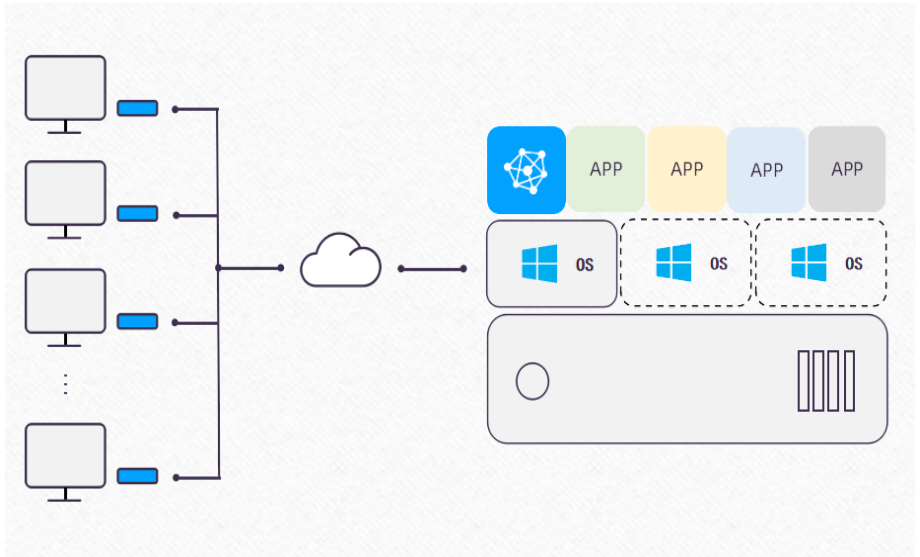
Server Virtualization

- Allows multiple virtual servers to run on a single physical server
- By sharing the underlying hardware resources



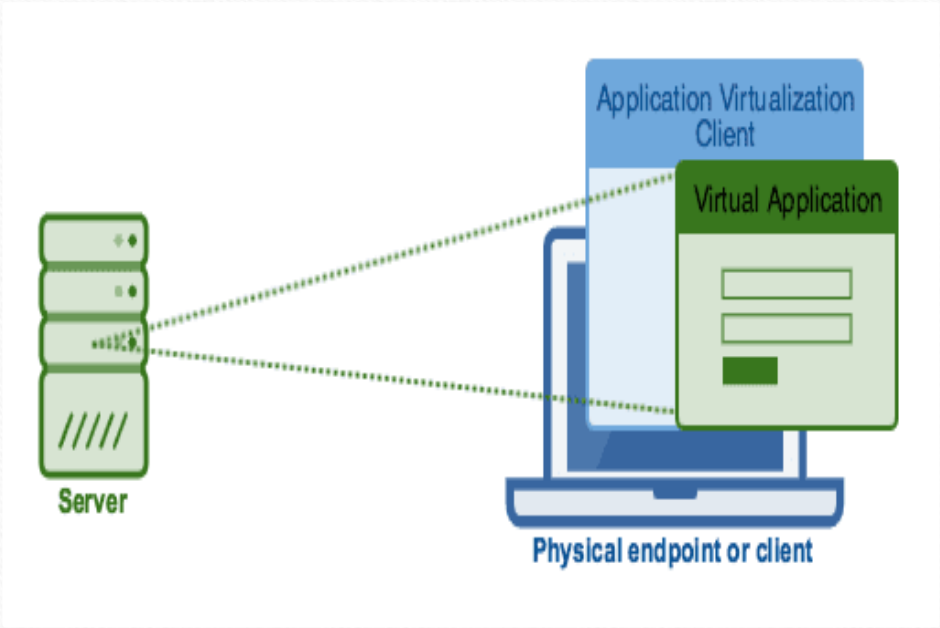
Desktop Virtualization

- Multiple virtual desktops to run on a single physical machine
- Each user have his separate desktop environment



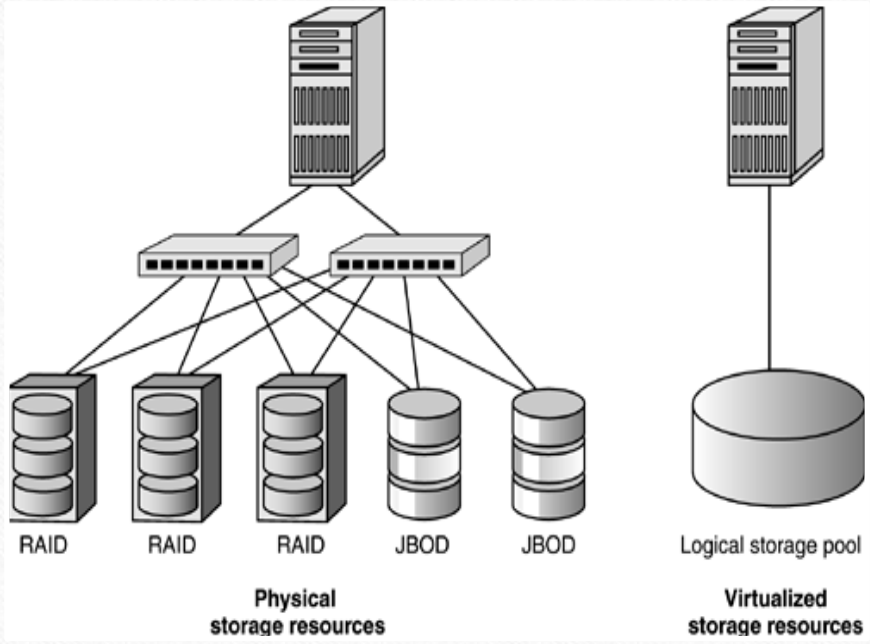
Application Virtualization

- Allows applications to run on a virtualized operating system
- Separate from the host OS



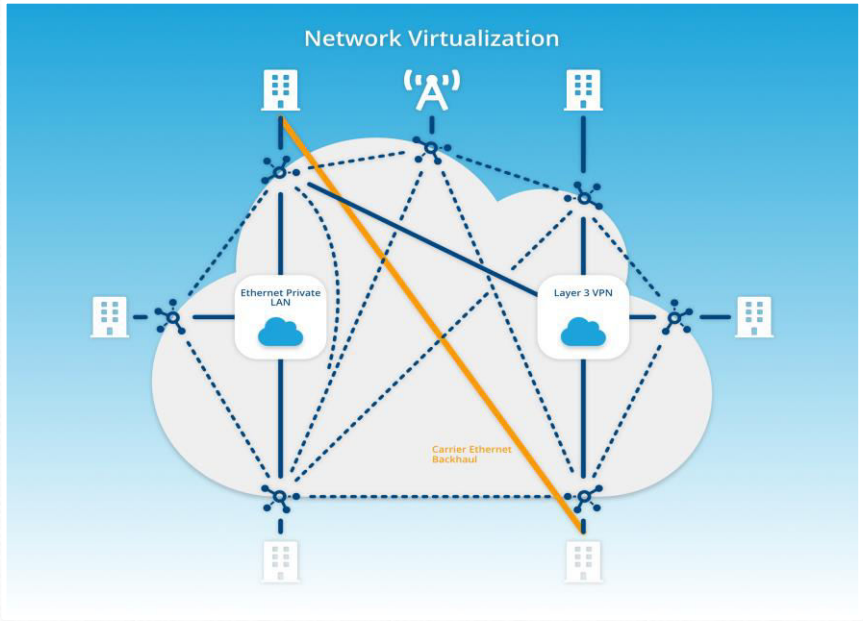
Storage Virtualization

- Pools storage resources from multiple physical devices into a single virtual storage device
- Making it easier to manage storage and improve utilization



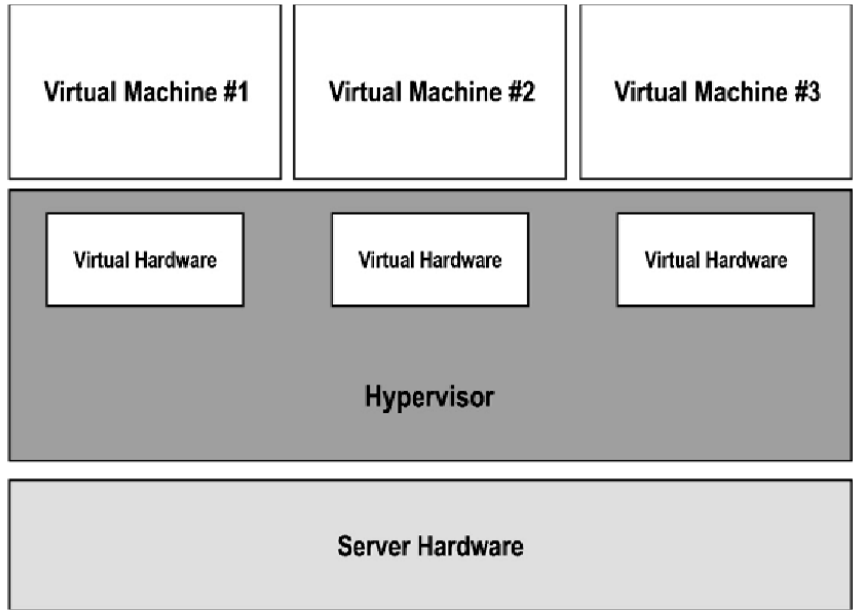
Network Virtualization

- Creates virtualized versions of physical network devices as such switches and routers
- Multiple virtual networks to run on a single physical network



Hardware Virtualization

- Creates virtualized versions of physical hardware devices, such as GPUs
- Allows multiple virtual devices to run on a single physical device



Application level Virtualization

Week 2 (part 1)

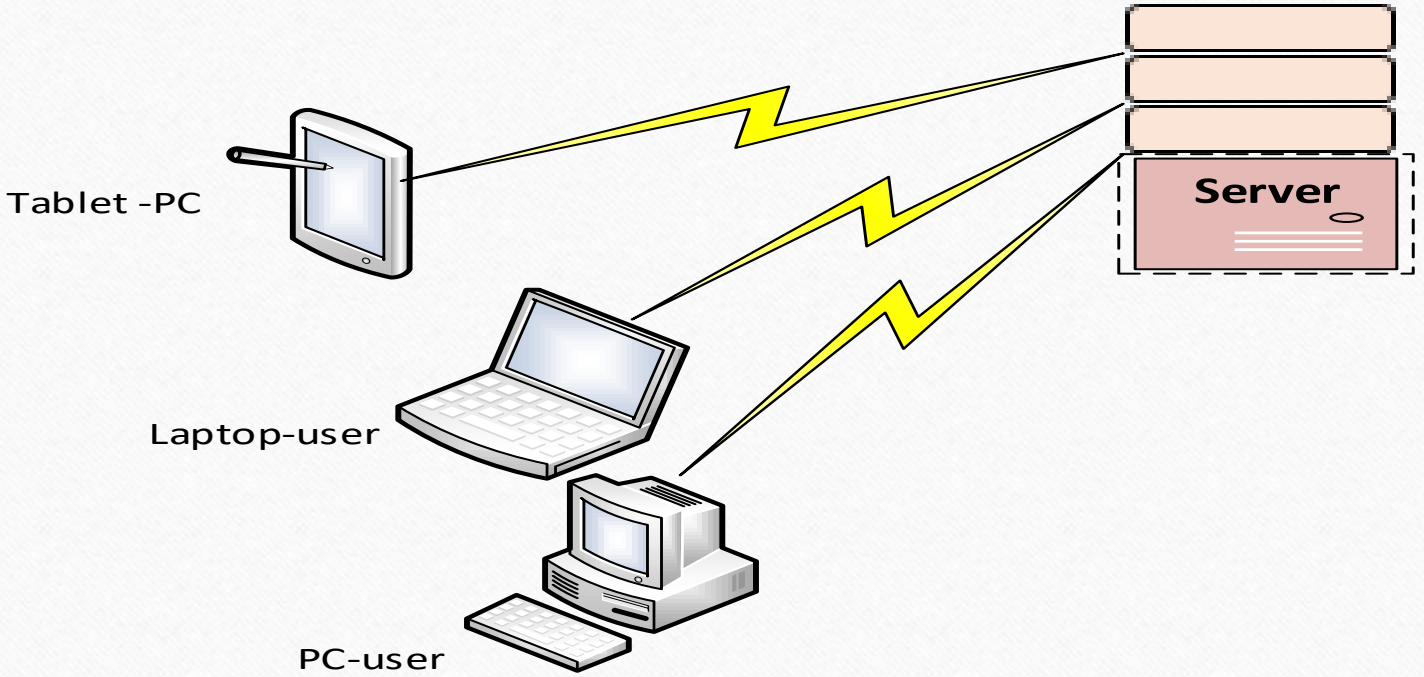
Application Virtualization

- **Topics to be Covered**:
  - What is Application Virtualization?
  - Benefits of Application Virtualization
  - Limitations of Application Virtualization

What is Application Virtualization?

- Application level Virtualization is a technique in which client applications are hosted remotely instead of installing them on clients local devices.
- In this type of technology, the local devices provide physical resources like CPU and RAM that may be required to run the software, but nothing is installed locally on the device itself.
- This technology separates the application from the underlying OS that is execution of application is independent of OS
- In this environment, the application actually runs remotely but virtually runs locally.

Application level Virtualization



Benefits of Application Virtualization

- **Reduce cost**
- **Enable Cross Platform Operations**: (Windows applications run on LINUX and vice versa)
- **Simplified Management**
- Application Virtualization allows an IT admin to manage and maintain applications across an organization rather than manually installing applications to every user's machine.
- Security and Stability Improved by isolating the application from the OS.

Benefits of Application Virtualization

- Prevent conflicts with other Virtualized Apps
- Permits users to run multiple App Instances:

Limitations of Application Virtualization

- **Single Point of Failure**: launching all Apps on servers increases the risk of failure.
- **Bandwidth Requirements**: sufficient bandwidth required for Streaming Apps to end-users
- **Problematic Applications**: Some Apps need system drivers and don't work as virtualized applications.
- **High Initial Investment**: Initially migrating data to the Data Center or cloud
- **Challenging Quick Scalability**: to ensure all the requisite software, enough storage, security and resource availability is a tedious job.

Comparison of Desktop and Application Virtualization

Week 2 (part 2)

Comparison

Desktop Virtualization

- It is the practice of hosting a Desktop Operating system and applications within a Virtual Machine on a centralized server or cloud
- In this technique, Desktop OS and Applications are decoupled from a hardware system that access it

Application Virtualization

- Application Virtualization is a practice of hosting Applications only on remote host or server.
- In this technique, Applications are decoupled from a hardware system that access it

Comparison

Desktop Virtualization

- Desktop runs as Virtual Machines in a secure Data center
- Each VM is called as Virtual desktop
- Different vendors Virtual desktops can be hosted on virtual server to access.
- The users may be connected from anywhere, anytime to the central server and access Virtual desktop

Application Virtualization

- Applications actually runs on secure server in Data center
- Each Application is called as Virtual application
- Different vendors applications can be hosted on remote server to run
- The users may be connected from anywhere, anytime to the central server and runs applications

Comparison

Desktop Virtualization

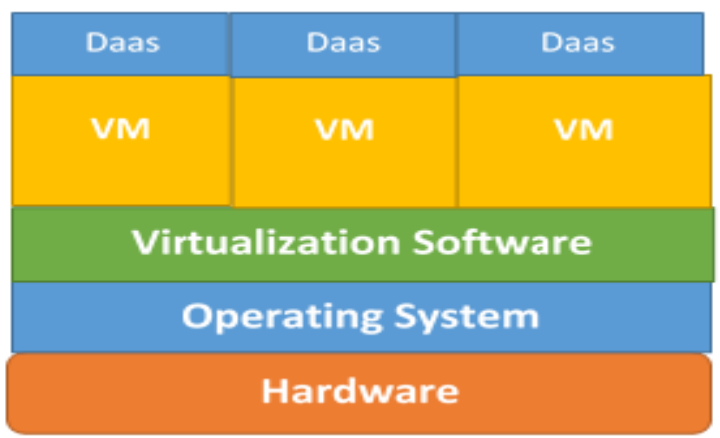
- The user may be a Desktop PC, laptop, thin client or mobile

Application Virtualization

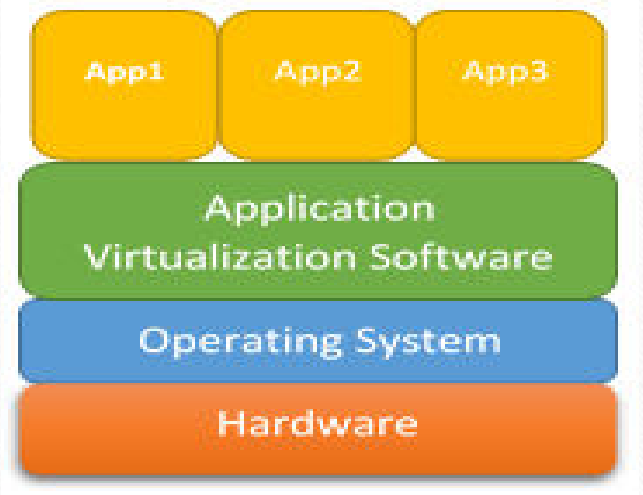
- The user may be a Desktop PC, laptop, thin client or mobile

Comparison

Desktop Virtualization



Application Virtualization



Solutions of Application Virtualization

Week 2 (part 3)

Solutions of Application Virtualization

- Different vendors provide methods or solutions to achieve Applications Virtualization.
- VMware Thin App
- Microsoft App-V
- Citrix Virtual Apps and Desktops
- Parallel Remote Application Server (RAS)

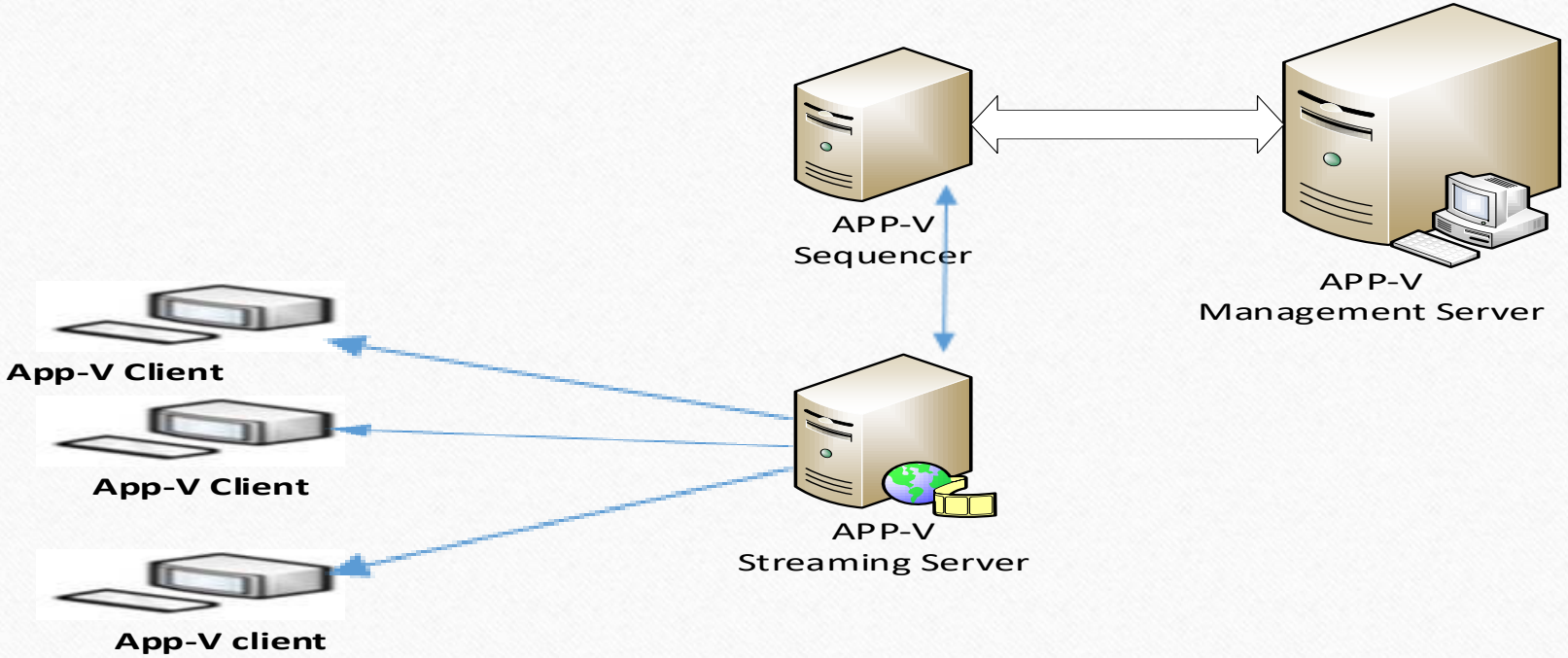
Microsoft App-V

- **On Remote host,**
  - Virtualization App-V server components are required to be installed.
  - App-V server components include
    - App-V Management server,
    - App-V Sequencer
    - App-V Streaming Server
  - Virtual Applications are installed on centrally managed server
  - The App-V Sequencer converts application data into an App-V package for virtualized delivery
  - The package can be streamed down to the clients on demand and cached locally

Microsoft App-V

- **On Client machine,**
  - App-V client is installed that runs virtualized applications on user devices
  - The App-V client presents a list of applications to the end-users to which that user has access

App-V Architecture



Software Define Data center SDDC

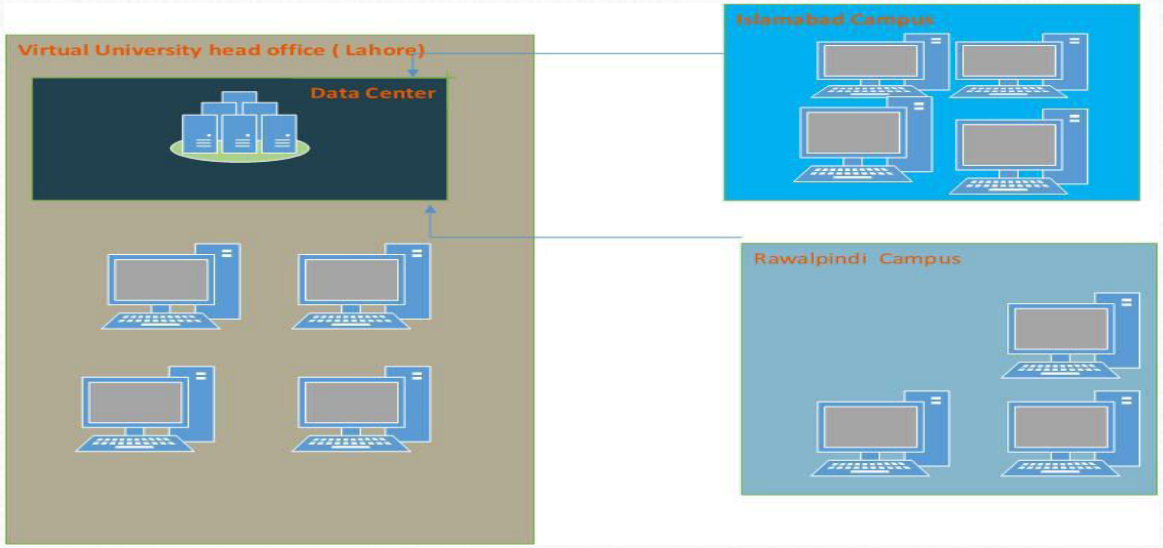
Week 3 (part 1)

Software Define Data center SDDC

- **Topics to be Covered**:
  - What is Data Center ?
  - What is Software Define Data center SDDC?
  - Component of SDDC?

What is Data Center?

- A data center is a **place** that **gives people** access to **apps** and data **through** a **complicated** network **of computer** and storage **systems**

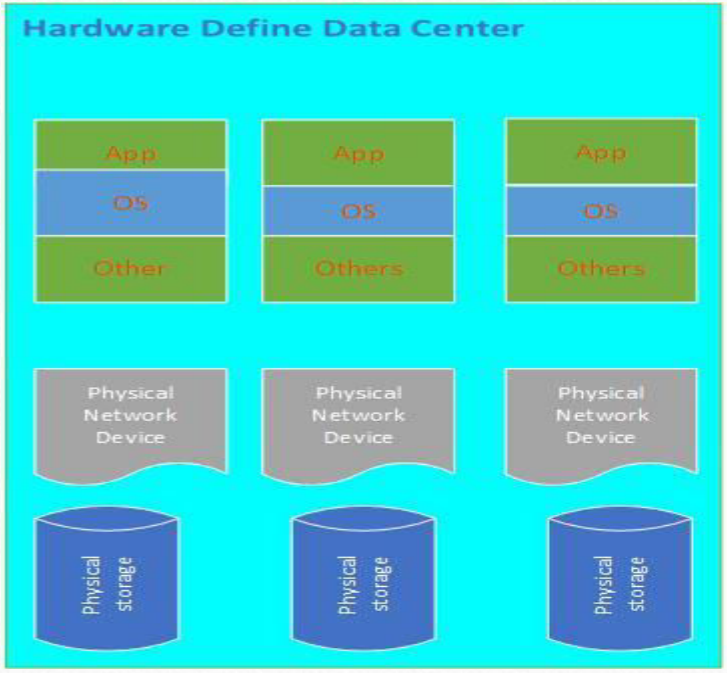


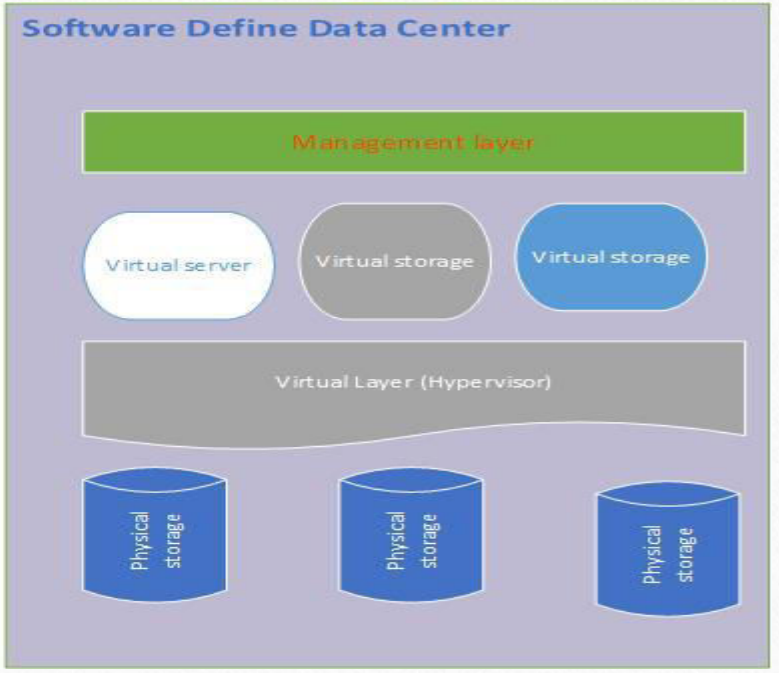
Software define Data center(SDDC)?

- **Keeping** your data center **up-to-date with the latest technology means using** software-**based components.**
- Provide different software to manage and automate the environment
- Better way of controlling the data Center
- Reduced it complexity
- Centralized management

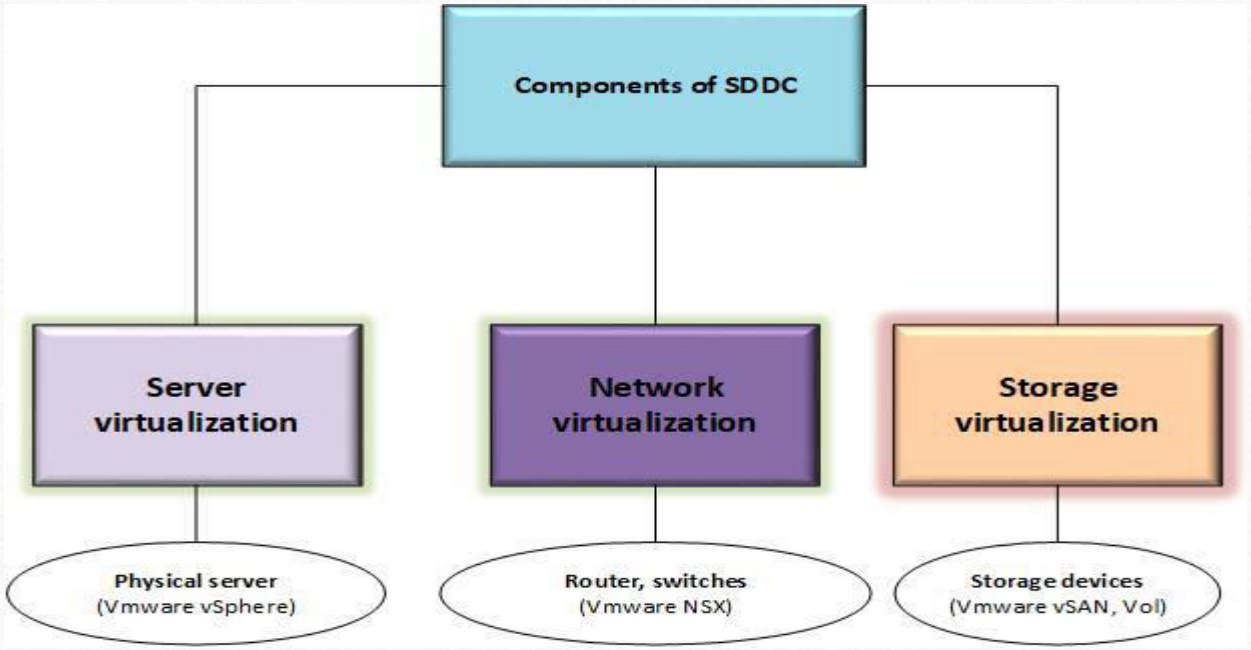
Software define Data center(SDDC)??

- ?



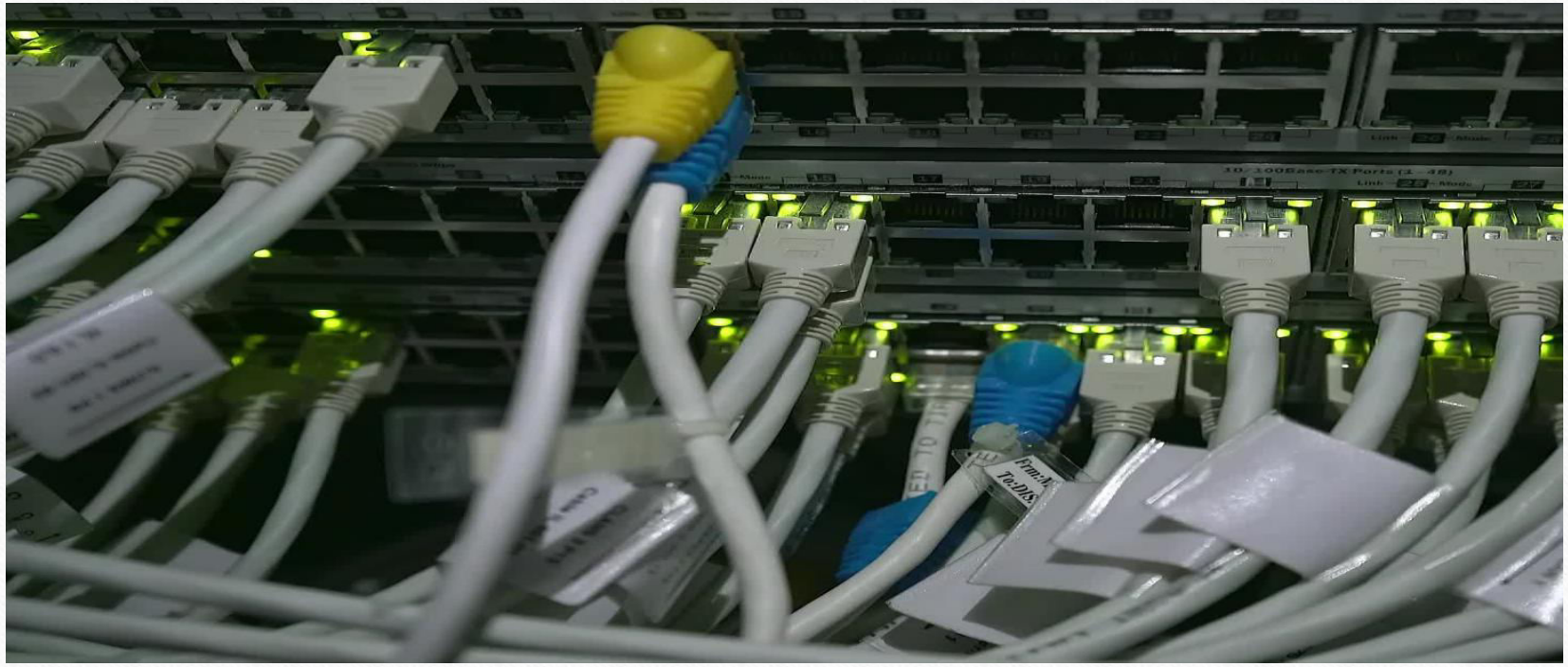


Component of SDDC?



Components of a Data Center

Week 3 (part 2)



Components of a Data Center

Computer System	The computer systems in a data center are the servers that are used to process, store, and distribute the data
Telecommunication System	The telecommunication equipments in a data center is used to connect the computer systems to the outside world. This includes routers, switches, and firewalls.
Storage System	The storage systems in a data center are used to store the data that is processed by the computer systems. This can include customer records, financial information, and business applications.

Components of a Data Center

Power systems	The power systems in a data center are used to provide continuous power to the computer systems and other equipment. These systems are typically designed to be highly reliable and redundant
Cooling systems:	The cooling systems in a data center are used to keep the temperature down from the computer systems and other equipment. These systems are typically designed to be highly efficient and to prevent the equipment from overheating.
Security systems	The security systems in a data center are used to protect the data and equipment from unauthorized access. These systems typically include physical security measures, such as access control and video surveillance, as well as logical security measures, such as firewalls and intrusion detection systems.

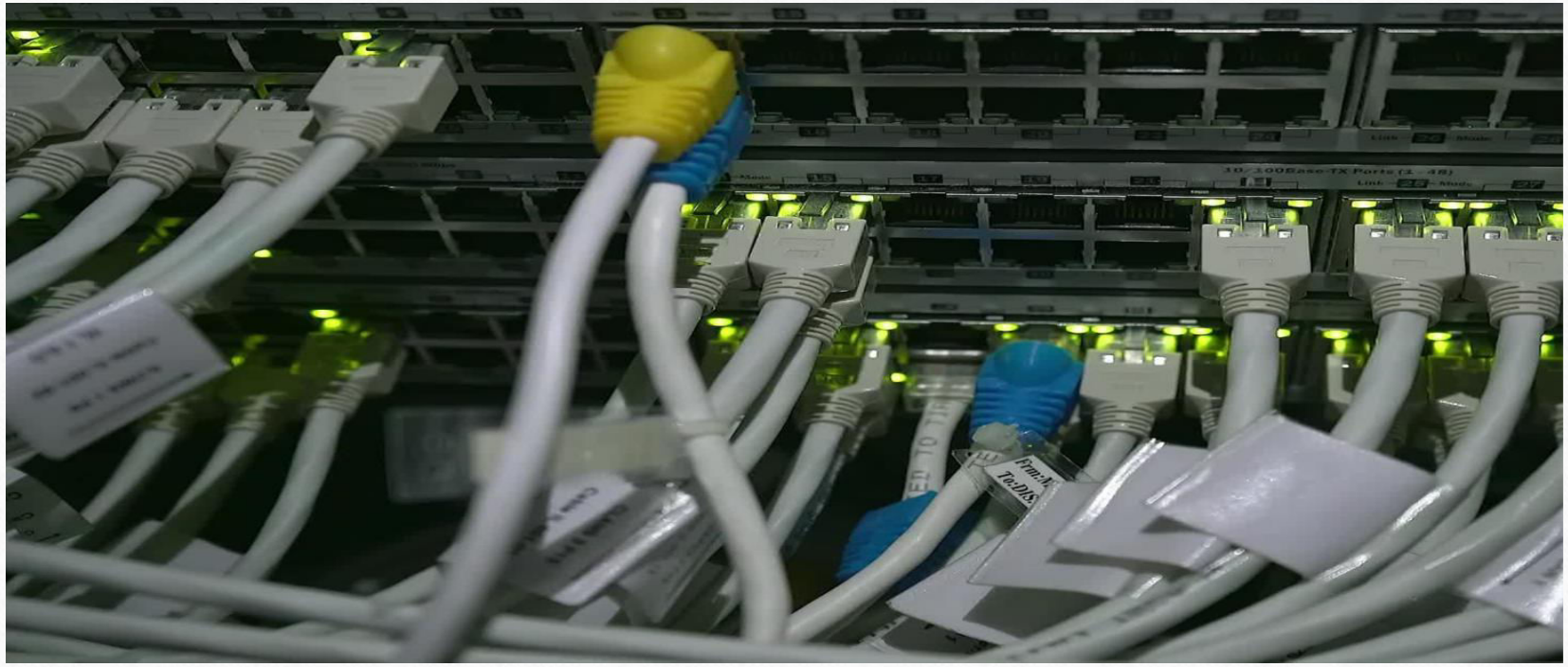
Components of a Data Center

Remember

Learning is a continuous process. So keep learning and keep creating and Sharing with others!

Purpose of SDDC?

Week 3 (part 3)



Purpose of SDDC?

Abstraction	Abstraction of underling hardware (Physical CPU, RAM, Network)
Pooling	Pooling of resources
Automation	Automate the deliver of IT services

Abstraction

- In virtualization, abstraction refers to the process of hiding the underlying physical hardware from the user. This allows the user to view and interact with the resources as if they were dedicated to them, even though they are actually sharing resources with other users or virtual machines.

Pooling of resources

- In virtualization, pooling refers to the grouping together of physical resources, such as CPU, memory, storage, and network bandwidth, so that they can be shared by multiple virtual machines. This allows organizations to improve the utilization of their IT infrastructure and reduce costs.

Architecture of Server Virtualization

Week 4 (part 1)

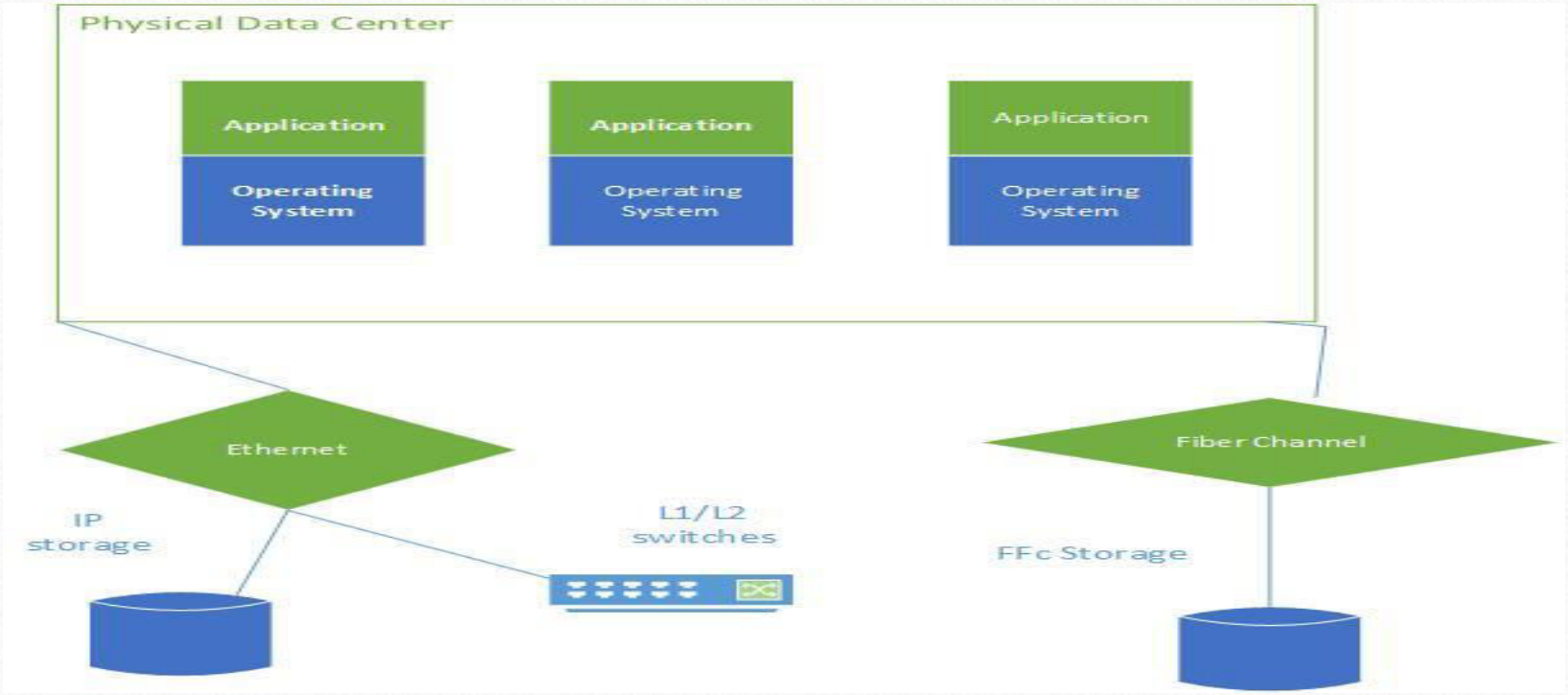
Architecture of Server Virtualization

- **Topics to be Covered:**
  - **The design of a physical data center. ?**
  - The design of a virtual data center.?
  - Resource sharing ?

The design of a physical data cent?

- In a physical data center, there are physical servers running.
- APP and Operating system are running on physical server
- **An** Ethernet switch is linked up with l2 and l3 switches**,** plus IP**-based** storage**.**

The design of a physical data cent?



Architecture of Server Virtualization

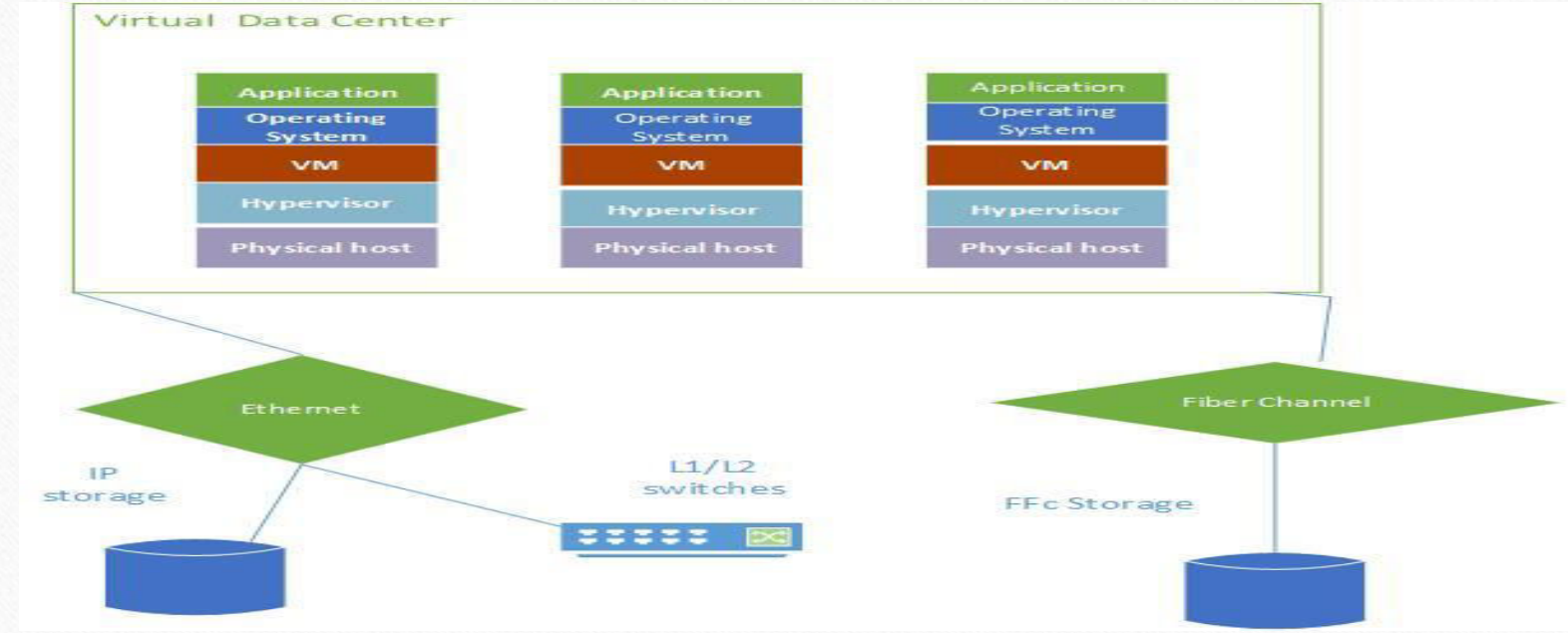
Week 4 (part 2)

Architecture of Server Virtualization

- **Topics to be Covered**:
  - The design of a physical data center. ?
  - **The design of a virtual data center.?**
  - Resource sharing ?

The design of a Virtual datacenter?

- We can use a Virtual Data Center to get several virtual machines running on minimal hardware..



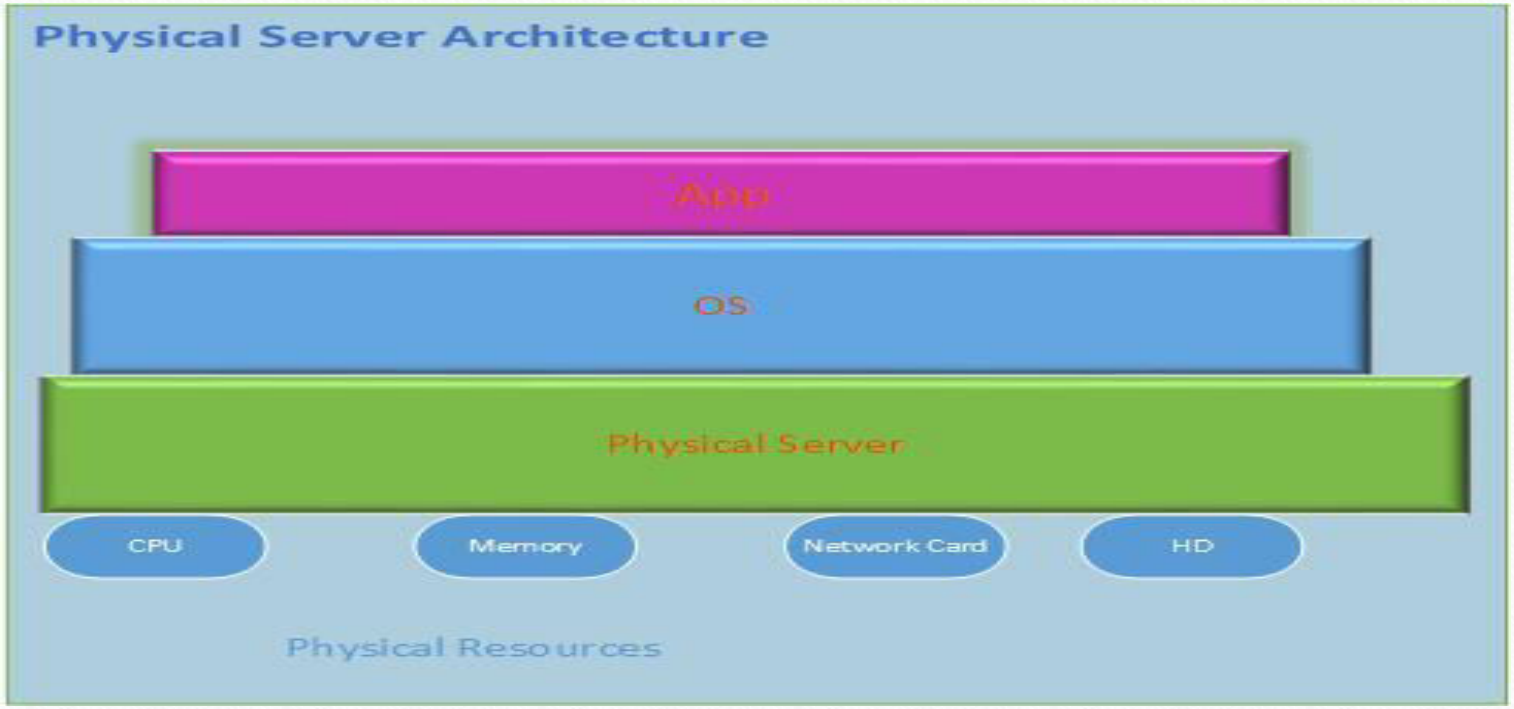
Architecture of Server Virtualization

Week 4 (part 3)

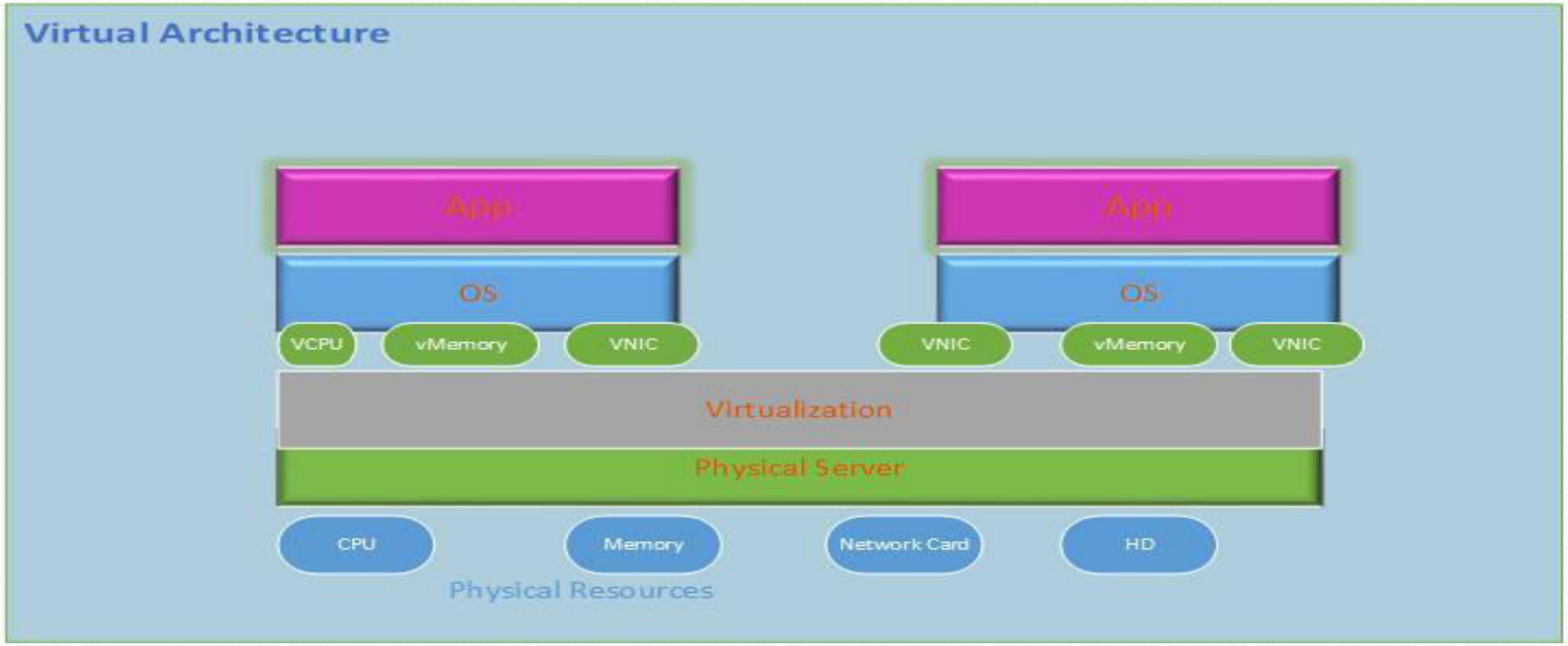
Architecture of Server Virtualization

- **Topics to be Covered:**
  - **The design of a physical data center. ?**
  - **The design of a virtual data center.?**
  - Resource sharing

Resource Sharing Physical Server?



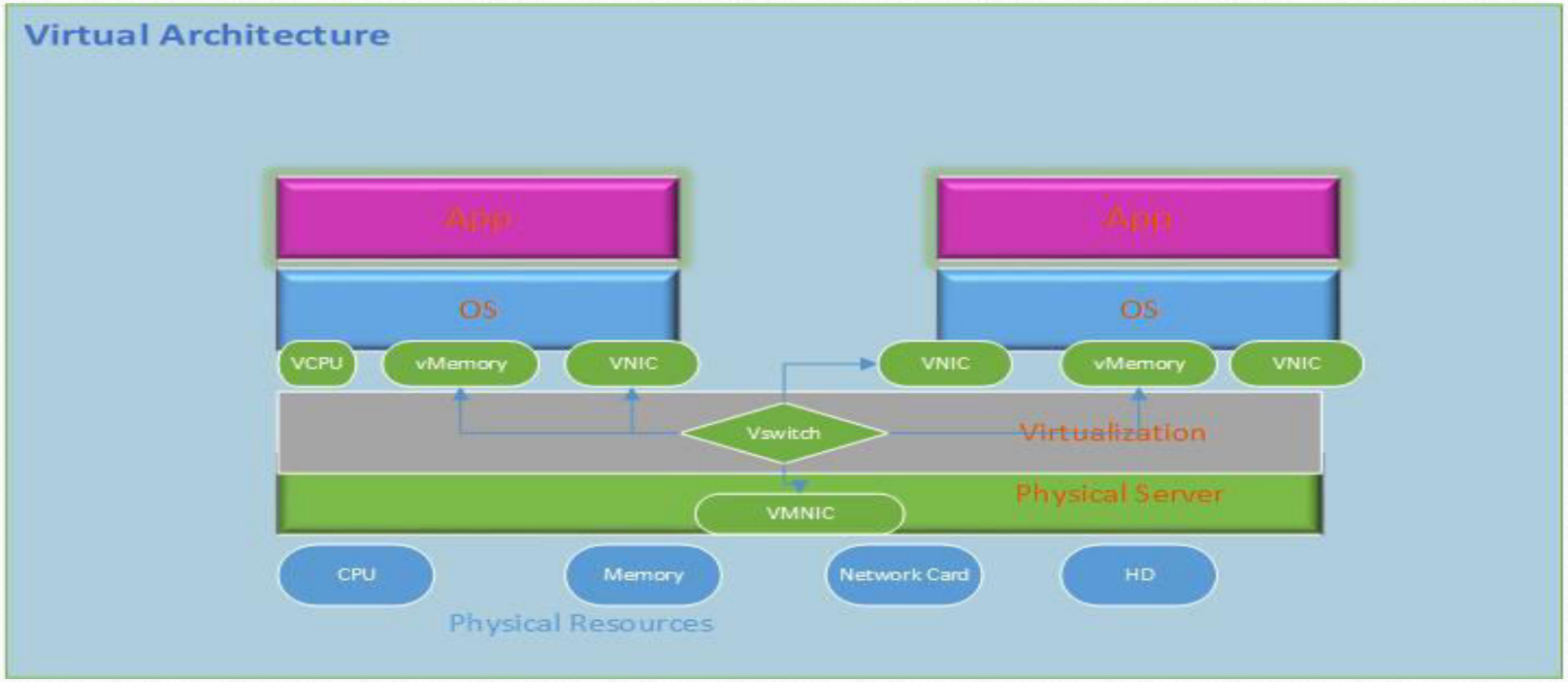
Resource Sharing Virtual data center?



Resource Sharing Virtual data center?

- **CPU**
- Maximum number of vCPU on VM depends on
  - number of logical CPU on the physical host
  - Type of OS on VM,
  - VMware supports up to 128 vCPU on one VM
- **Memory**
- Maximum number of virtual memory on VM depends on
  - Maximum memory available on Physical host
  - Type of OS on VM
- VMware supports up to 6TB Virtual memory on one VM

Resource Sharing Virtual data center?

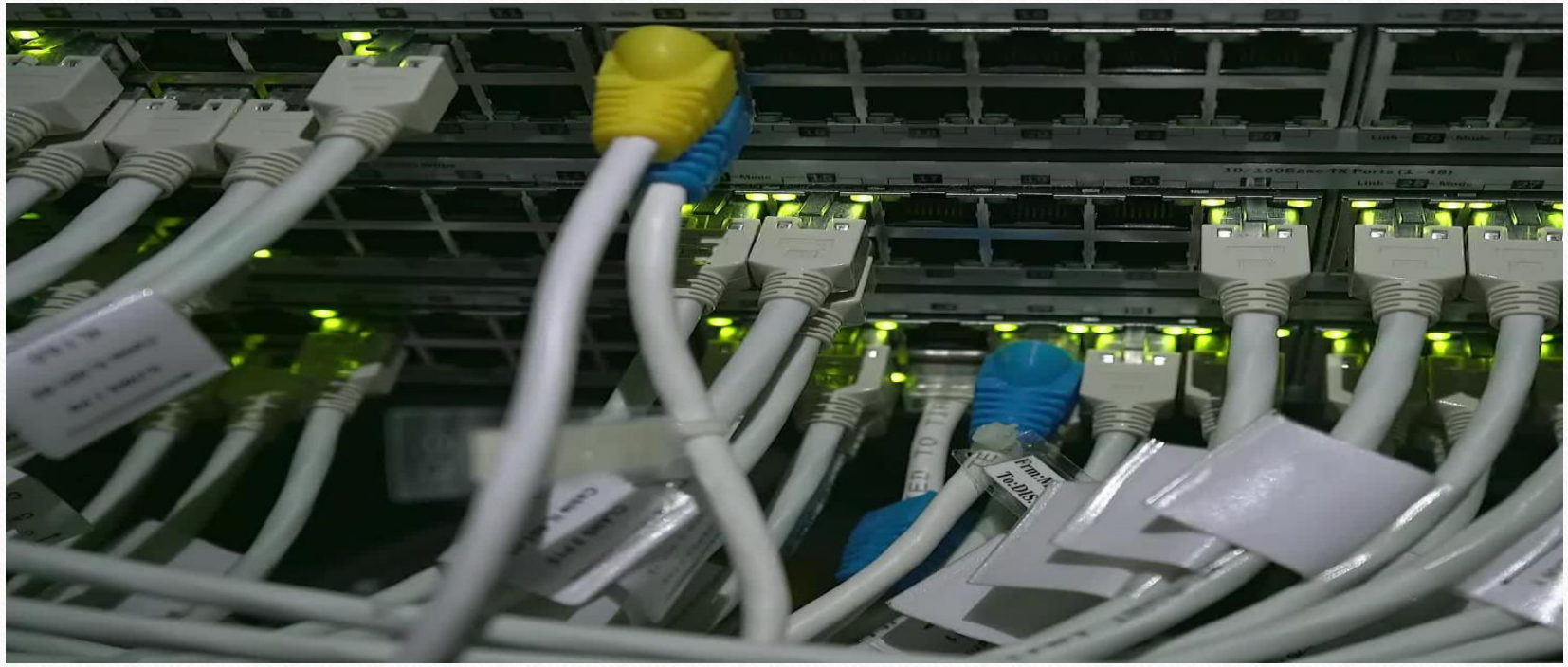


Resource Sharing Virtual data center?

- VM support up to 10 VNIC

Examples of server virtualization software:

Week 4 (part 4)



Examples of server virtualization software

VMware vSphere	vSphere is a server virtualization software application from Vmware.It is a complete virtualization platform that includes a hypervisor, vCenter Server for centralized management, and a suite of tools for managing virtual machines (VMs), storage, networking, and security.
Microsoft Hyper-V	Hyper-V is a Microsoft virtualization product or or 'hypervisor', allowing you to create and run multiple VMs on a physical host. It is a type-1 hypervisor, which means that it runs directly on the physical hardware and provides a direct interface to the physical resources.
Citrix Hypervisor	Citrix Hypervisor is a type-1 hypervisor that is optimized for virtual app and desktop workloads. It is developed by Citrix Systems and is built over the Xen virtual machine hypervisor

Examples of server virtualization software

Nutanix AHV	It is a Type 1 hypervisor, which means that it runs directly on the physical hardware without the need for a separate operating system. Nutanix is one of the most well-known vendors that provides cloud computing services and software-defined storage
•Red Hat Virtualization	The cooling systems in a data center are used to remove heat from the computer systems and other equipment. These systems are typically designed to be highly efficient and to prevent the equipment from overheating.
Security systems	The security systems in a data center are used to protect the data and equipment from unauthorized access. These systems typically include physical security measures, such as access control and video surveillance, as well as logical security measures, such as firewalls and intrusion detection systems.

Components of a data center

Remember

learning is a continuous process. So keep learning and keep creating and Sharing with others!💻✌

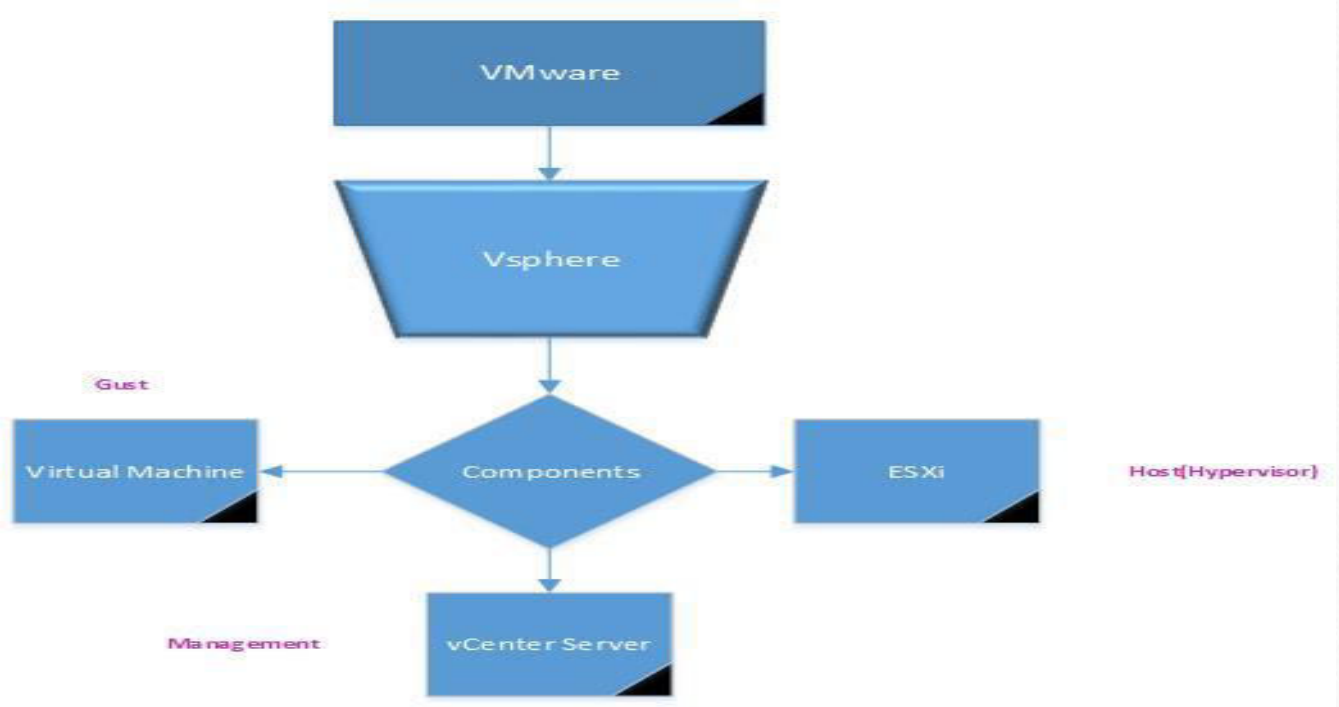
Virtualization Technologies

Week 5 (part 1)

vCenter

- **Topics to be Covered:**
  - **VMware vSphere ?**
  - **ESXI**
  - **Virtual Machine**
  - **VCenter Server**

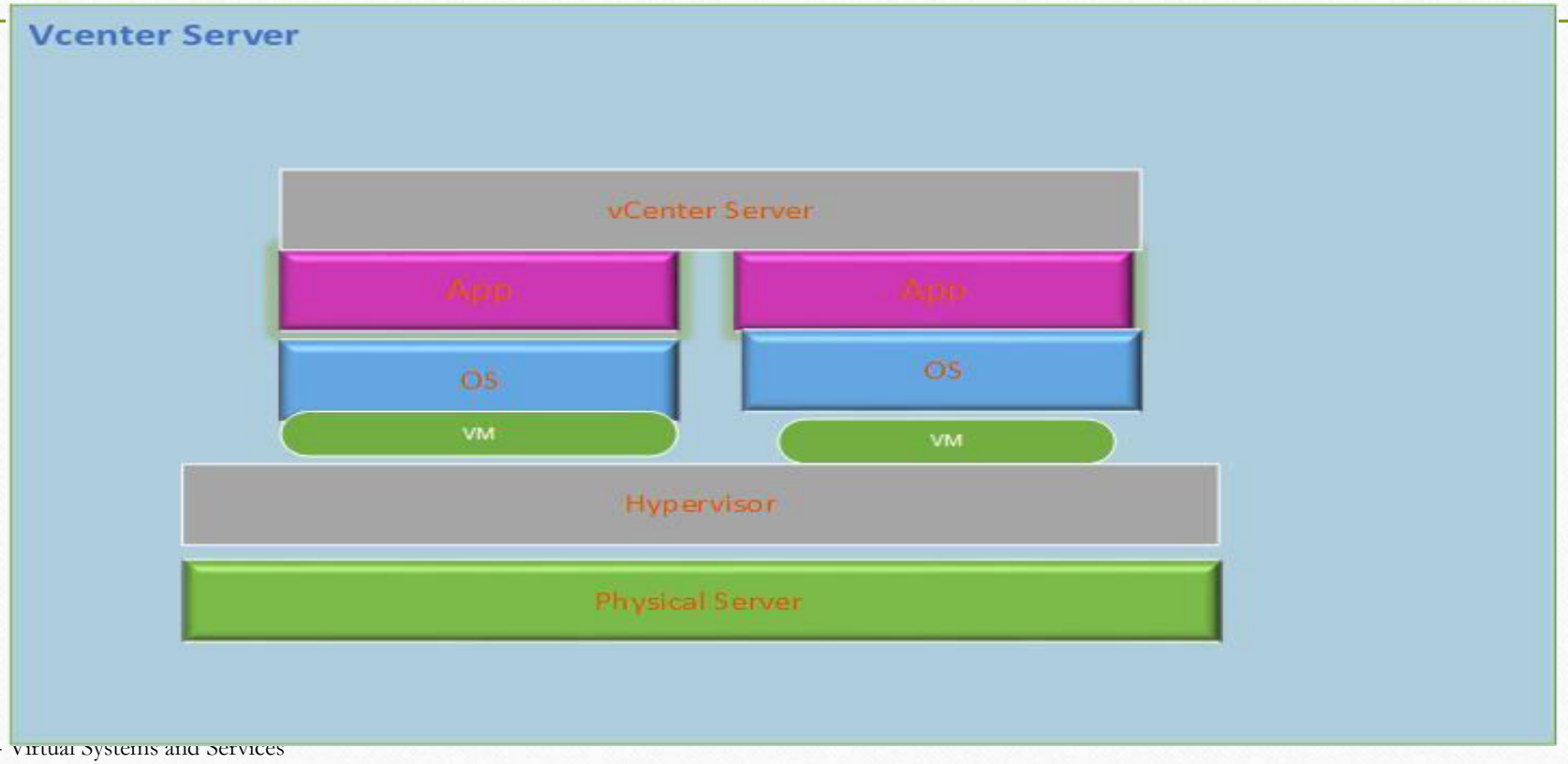
vCenter


VMware
Vsphere
Gust
Virtual Machine
Components
ESXi
Host(Hypervisor)
Management
vCenter Server

What is vCenter Server ?

- Manage entire Virtualization Data Center
- Before Virtualization (Manually visit Data Center)
- Management consoles
- It also perform day to day task for example take snap shot etc

vCenter Server



Virtualization Technologies

Week 5 (part 2)

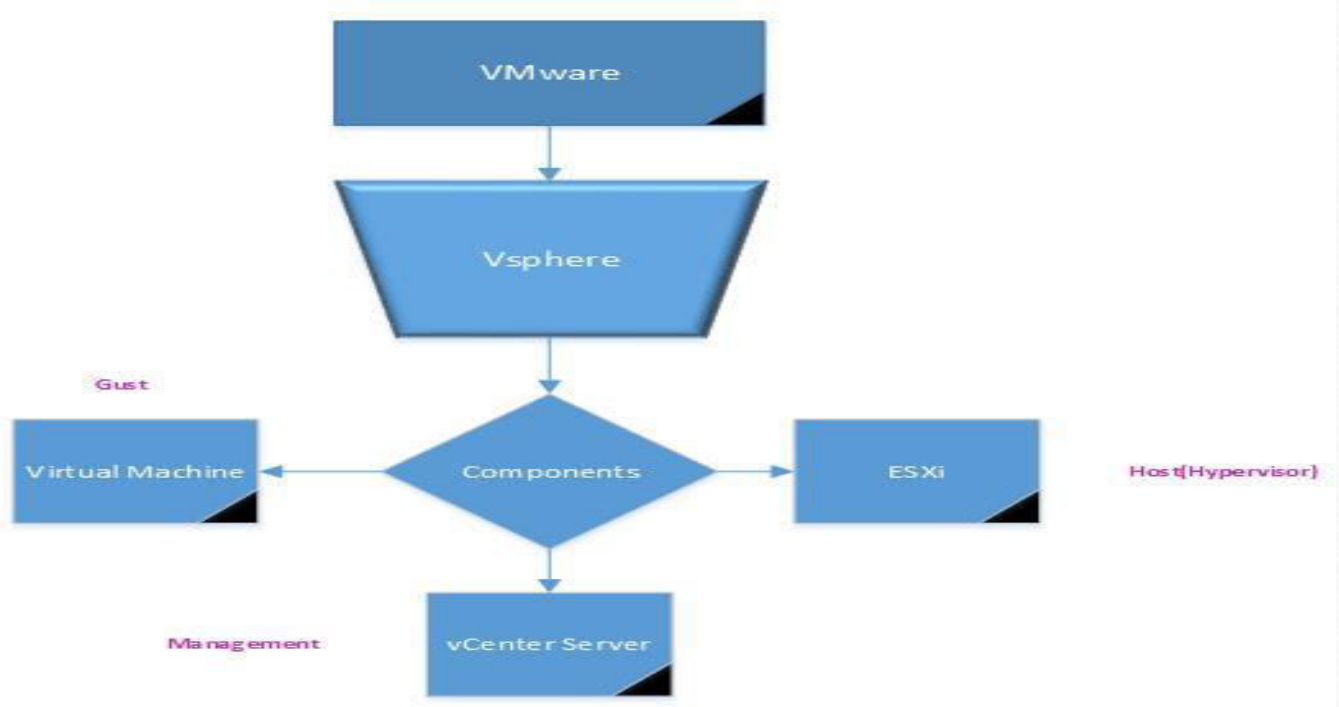
Architecture of Server Virtualization

- **Topics to be Covered:**
  - **VMware vSphere ?**
  - **ESXI**

VMware vSphere?

- VMware is vendor who provide software's for server virtualization
- Version 6.7 vSphere (Current)

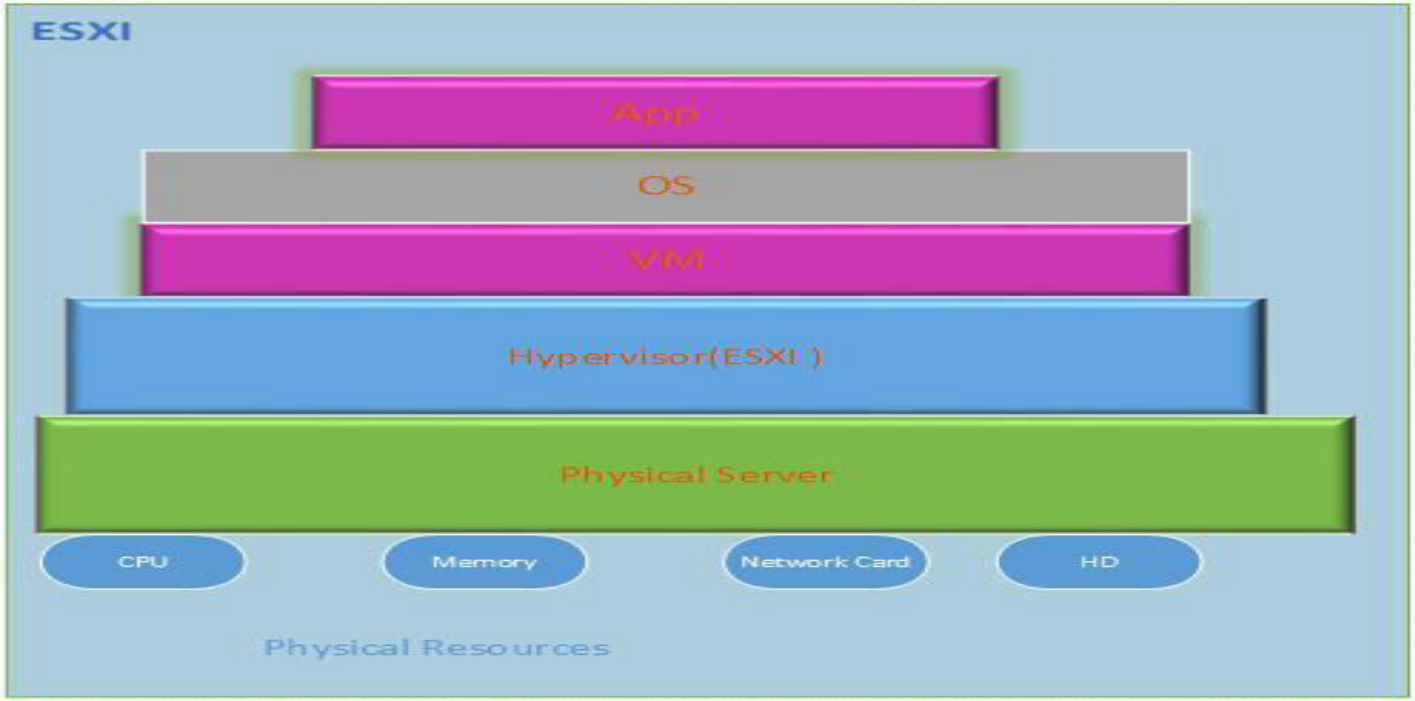
Component of Vsphere



ESXI

- ESXI is Hypervisor
- A hypervisor allows one host computer to support multiple guest VMs by virtually sharing its resources, such as memory and processing.
- Direct install on physical server as OS
- Assigned resources from physical server to VM

ESXI

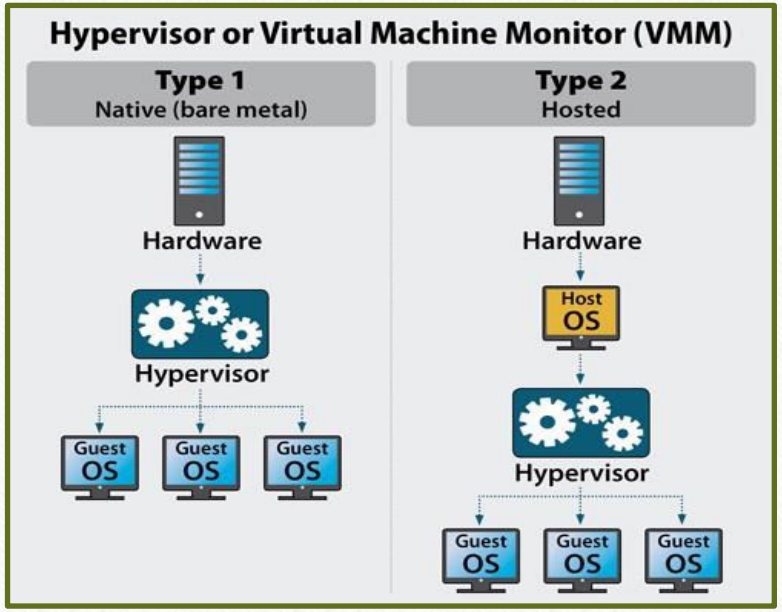

ESXI
App
OS
VM
Hypervisor(ESXI)
Physical Server
CPU
Memory
Network Card
HD
Physical Resources

Hypervisor

Week 6 (part 1)

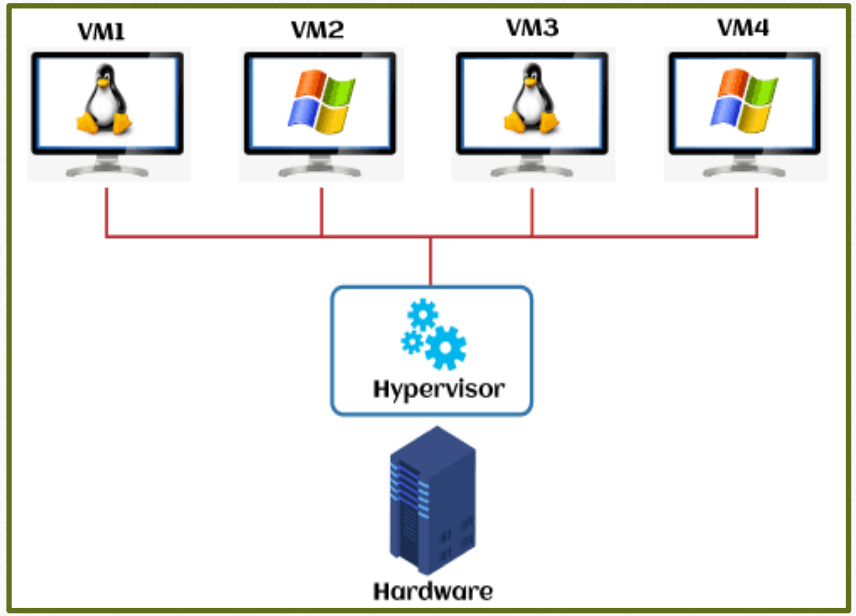
Hypervisor

- **Topics to be Covered:**
  - A software layer
  - Creates and manages virtual machines (VMs)
  - Acts as a virtualization layer b/w the physical hardware and (VMs)
  - Allows multiple VMs to share the underlying hardware resources of Host



Hypervisor

- Allows multiple operating systems to run on a single physical server
- Improving the utilization and flexibility of the underlying hardware resources



Components of Hypervisor

- **Virtual Machine Monitor (VMM):**

  Core component, manages Virtual Machines

- **Virtual Devices:**

  NICs, virtual hard drives, and virtual switches used to provide virtual versions of physical devices

- **Virtual Machine Executables (VMEs):**

  Virtual versions of operating systems that run on virtual machines

- **Drivers:**

  Provide access to the physical hardware resources of a host device

Components of Hypervisor

- **Management Interface:**

  Interface that allows administrators to create, manage, and monitor virtual machines (VMs)

- **Virtual Machine File System (VMFS):**

  Stores virtual machines and their configuration files

It was a general overview of the Hypervisor structure it may vary from type to type

Types of Hypervisors

Week 6 (part 2)

Types of Hypervisors

There are two main types of hypervisors:

- Type 1:

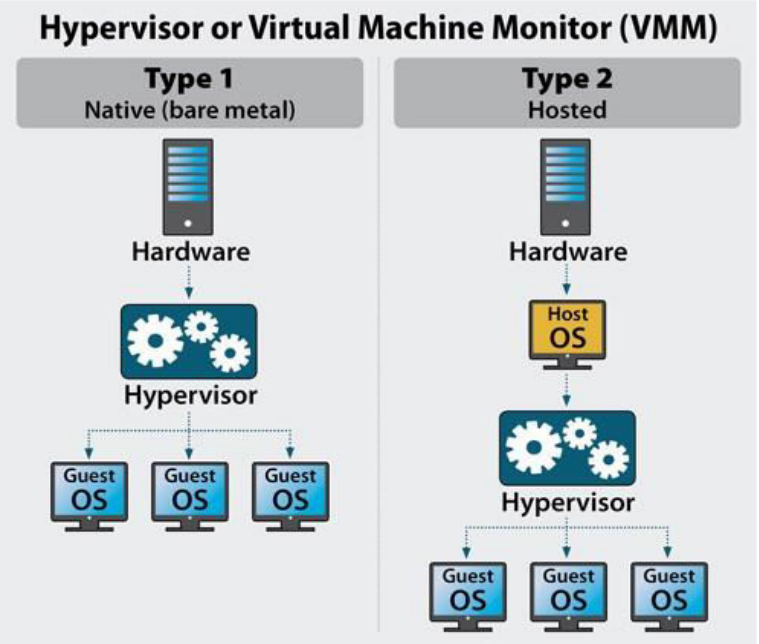
  -also known as bare-metal hypervisors

  -run directly on the host's physical hardware

- Type 2:

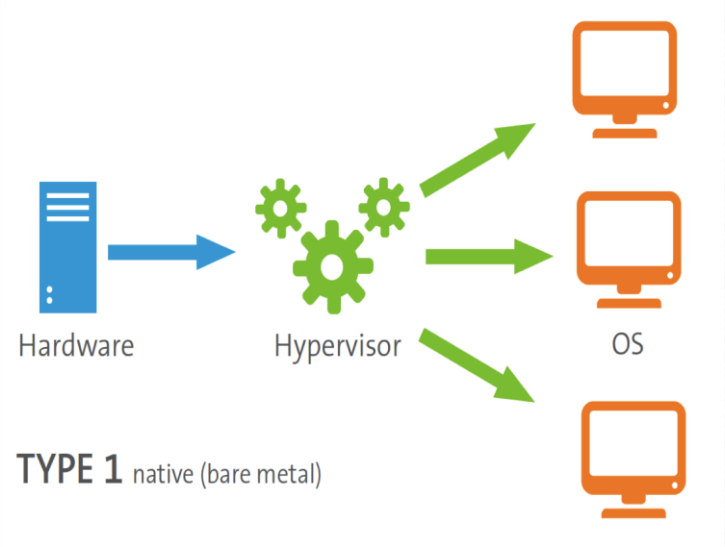
  -also known as Hosted Hypervisor

  -run as an application on a host operating system



Type 1 Hypervisor

- Type 1 or bare-metal hypervisors, are virtualization software
- Runs on host's physical hardware.
- Not dependent on any host operating system
- Controls the underlying hardware resources of host
- Provides virtualized environments for guest operating systems



Examples of Type 1 Hypervisor

- **VMware vSphere**

  -complete virtualization solution for data centers

  -used in large enterprise environments and cloud infrastructures

- **Microsoft Hyper-V**

  -provides virtualization support for Windows Server operating systems

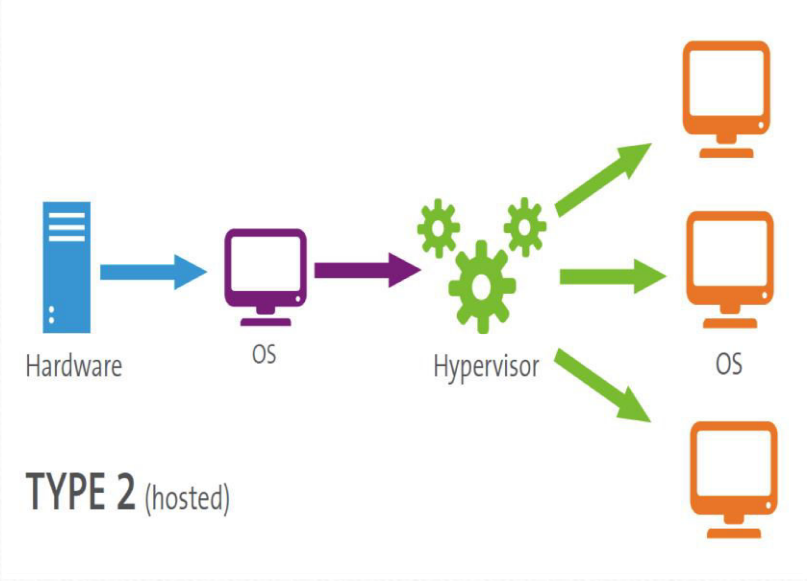
  -widely used in enterprise environments with a strong Microsoft technology presence.

- **Citrix XenServer**

  -has a strong presence in the financial services and healthcare industries

Type 2 Hypervisor

- Commonly used for software development, testing, and personal desktop virtualization
- Used where a higher level of performance is not as critical
- Less secure than Type 1 hypervisors
- Vulnerable to attacks on the host operating system



Examples of Type 2 Hypervisor

- Oracle VirtualBox

  -supports a wide range of host and guest operating systems

  -used for personal virtualization, software testing, and development

- VMware Workstation

  -commercial hypervisor

  -supports multiple operating systems, snapshots and cloning of virtual machines

  -support for virtualized hardware such as virtualized GPUs and virtualized USB devices.